COSEWIC
Assessment and Status Report

on the

Baird's Sparrow
Ammodramus bairdii

in Canada

SPECIAL CONCERN
2012

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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COSEWIC
Assessment Summary

Assessment Summary – May 2012

Common name
Baird's Sparrow

Scientific name
Ammodramus bairdii

Status
Special Concern

Reason for designation
Canada supports about 60% of the breeding population of this prairie songbird. The species was common and perhaps even abundant historically. It suffered declines stemming from agricultural conversion of its native prairie habitat across the Great Plains. There is good evidence for population declines in recent decades, but the species is difficult to monitor effectively, and information on short-term population trends is relatively weak. Loss and degradation of its specialized grassland habitat, on both its breeding and wintering grounds, are believed to pose the most significant threats. Evidence of long-term population declines, coupled with ongoing threats to habitat, are the primary reasons for elevating the status of this species from Not at Risk to Special Concern.

Occurrence
Alberta, Saskatchewan, Manitoba

Status history
Designated Threatened in April 1989. Status re-examined and designated Not at Risk in April 1996. Status re-examined and designated Special Concern in May 2012.

COSEWIC
Executive Summary

Baird's Sparrow
Ammodramus bairdii

Wildlife Species Description and Significance

The Baird's Sparrow is a secretive grassland sparrow, distinguished from other sparrows by "moustache" marks on its yellowish-ochre face, a necklace of thin streaks across its breast, and a song that usually ends in a wiry, musical trill. As a range-restricted species of the northern prairies, it is a valuable grassland indicator for that region.

Distribution

The Baird's Sparrow breeds from southern Alberta, Saskatchewan and southwest Manitoba, south to Montana, Wyoming, and South Dakota. Canada encompasses about 45% of its breeding range, and is home to an even greater proportion of the global population. Baird's Sparrows winter from southern Arizona, New Mexico, and Texas south to north central Mexico.

Habitat

This species mainly breeds in large patches of mixed grass and fescue prairie with sparse shrubs, moderate grass heights, and some litter. These features can sometimes be met by non-native habitats, but breeding success can be poor in some of these habitats, such as tame hay and croplands. Over 75% of native grassland in the Baird's Sparrow's breeding range has been destroyed since the 1800s, mostly converted to cropland. Habitat destruction, degradation, and fragmentation continue across the species' range.

Biology

Baird's Sparrows likely breed in their first year and live about 3 years. They nest in late May through July, raising an average of 1.5 young during each of the one or two breeding attempts they have each year. About half of nests fail, with most lost to a variety of avian and mammalian predators. Birds rarely return to the same place to breed each year, but instead settle wherever conditions are suitable for breeding.

Population Sizes and Trends

The global population is estimated from Breeding Bird Survey (BBS) data as 1.2 million individuals (± 50%), of which 60% breed in Canada. The BBS shows a statistically non-significant annual average rate of decline of 2.0% in the population in Canada since 1970 (95% CI: -4.5 to 0.6). However, because Baird's Sparrows appear to shift their breeding distributions in response to patterns of precipitation, using combined long-term BBS data for Canada and the US is believed to represent a more appropriate source of population trend estimates. This yields a statistically significant decline of 25% (95% CI: -13 to -39) over the past decade.

Threats and Limiting Factors

The main threats to Baird's Sparrows are habitat destruction, degradation, and fragmentation, caused by a variety of factors, with energy extraction becoming particularly important recently. Other threats include disruption of natural processes (grazing, fire, and drought), agricultural operations, brood parasitism by cowbirds, pesticides, and climate change.

Protection, Status, and Ranks

The Baird's Sparrow is protected under the Canada-US *Migratory Birds Convention Act* and Manitoba's *Endangered Species Act*. It is recognized as being at risk on several non-legal status rankings across its range, including the US Birds of Conservation Concern and the Partners in Flight and Audubon Society Watch Lists. Various programs are in place to conserve native grassland, but less than 25% of the Canadian prairie region is still native grassland, and only 15% of native grassland across this species' range is protected.

TECHNICAL SUMMARY

Ammodramus bairdii
Baird's Sparrow Bruant de Baird
Range of occurrence in Canada (province/territory/ocean): Alberta, Saskatchewan, Manitoba

Demographic Information

Generation time - Estimated based on other small passerines.	2-3 yrs
Is there an estimated continuing decline in number of mature individuals?	Yes
Estimated percent of continuing decline in total number of mature individuals within 5 years. - Insufficient short-term trend data are available	Decline, but not calculated
Estimated percent reduction in total number of mature individuals over the last 10 years. - Estimated from an interpolation of range-wide, long-term Breeding Bird Survey (BBS) data.	25% (95% CI range: 13%-39%)
Inferred percent reduction in total number of mature individuals over the next 10 years. - Insufficient trend data are available	Unknown (not calculated)
Suspected percent reduction or increase in total number of mature individuals over any 10-year period, over a time period including both the past and the future. - Insufficient trend data are available	Unknown (not calculated)
Are the causes of the decline clearly reversible and understood and ceased? - Understood, but not clearly reversible and not ceased	No
Are there extreme fluctuations in number of mature individuals? Although local fluctuations can be extreme, these likely represent temporary shifts in occurrence rather than population fluctuation.	No

Extent and Occupancy Information

Estimated extent of occurrence	410,000 km²
Index of area of occupancy (IAO).	> 2,000 km²
Is the total population severely fragmented?	No
Number of locations	Unknown
Is there an observed continuing decline in extent of occurrence?	No
Is there an observed continuing decline in index of area of occupancy?	Unknown, but likely given population decline
Is there an observed, inferred, or projected continuing decline in number of populations?	Not applicable
Is there an observed, inferred, or projected continuing decline in number of locations?	Unknown
Is there an observed continuing decline in the area, extent and quality of habitat?	Yes (rate unknown)
Are there extreme fluctuations in number of populations?	Not applicable
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Total	715,000 (350,000-1,100,000)

Quantitative Analysis

Probability of extinction in the wild is at least 20% within 20 years or 5 generations, or 10% within 100 years.	No analysis done

Threats (actual or imminent, to populations or habitats)

Grassland habitat destruction, degradation and fragmentation on both the breeding grounds and wintering grounds; disruption of natural processes (grazing, fire, drought); nest losses stemming from agricultural operations; heightened brood parasitism; pesticides; and climate change.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? Declining; the long-term population trend in the US is -3.5%/year for the period 1988-2009 (95% CI: -5.5, -1.3).	
Is immigration known or possible?	Yes
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes, but limited and declining
Is rescue from outside populations likely?	Unlikely, because of declines in the US and limited and declining supply of breeding habitat in both countries

Current Status

COSEWIC: Threatened (April 1989); Not at Risk (April 1996)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Special Concern	Not applicable

Reasons for designation:

Canada supports about 60% of the breeding population of this prairie songbird. The species was once common and perhaps even abundant historically. It suffered severe declines stemming from agricultural conversion of its native prairie habitat across the Great Plains. There is good evidence for population declines in recent decades, but this species is difficult to monitor effectively, and information on short-term population trends is relatively weak. Loss and degradation of its specialized grassland habitat, on both its breeding and wintering grounds, are believed to pose the most significant threats. Evidence of long-term population declines, coupled with ongoing threats to habitat, are the primary reasons for elevating the status of this species from Not at Risk to Special Concern.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not meet criterion for Threatened (>30% decline over 10 years). The 10-year rangewide decline is estimated at 25% (95% CI: -13%, -39%), but there is some uncertainty about how robust this estimate is. There is also an indication that the population has been stabilizing recently.
Criterion B (Small Distribution Range and Decline or Fluctuation): Does not meet criterion. Exceeds thresholds for extent of occurrence and area of occupancy.
Criterion C: Does not meet criterion. Exceeds thresholds for population size (> 10,000 mature individuals).
Criterion D: Not applicable. Exceeds thresholds for population size, area of occupancy and number of locations.
Criterion E: Not done.

PREFACE

The Baird's Sparrow was first assessed by COSEWIC as Threatened in 1989 due to declines. It was later reassessed as Not at Risk in 1996, because of what later turned out to be a short-term increase in numbers of birds in the 1990s. This updated status report adds new information that has become available since the previous report. Population trend information gathered since the previous report now stretches across a longer timeframe and includes data from the Grassland Bird Monitoring program, which was just starting when the previous report was produced. Long-term population declines are now better documented. Likewise, habitat trends are also downward—a pattern that is anticipated to continue into the future because of ongoing and new threats to grasslands on both the breeding and wintering grounds. More information is also available on threats that might be posed by infrastructure associated with energy extraction projects, which are becoming increasingly prominent on the breeding grounds. For the species' biology, only a few new studies have appeared since the previous report, but they include information that is important for assessing status (e.g., on breeding success in agricultural habitats, staging during migration, and wintering habitat use). Levels of habitat protection have also been better documented. Last, the species has been newly ranked as being at risk in several status assessment schemes in the US.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2012)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

The Baird's Sparrow (French name = Bruant de Baird), *Ammodramus bairdii*, is a member of the New World sparrow family, Emberizidae, in the order of perching birds, Passeriformes. Recent DNA work suggests a stronger affiliation between this species and the genus *Melospiza* than with *Ammodramus* (Kerr *et al.* 2007), but the markers used might not be suited to determining such relationships (Rising 2007). Previous work on blood proteins suggested that the closest relative is Henslow's Sparrow, *A. henslowii* (Zink and Avise 1990).

Morphological Description

The Baird's Sparrow is a medium-sized sparrow, about the size of an American Goldfinch (*Spinus tristis*), averaging 19 g in weight and 12 cm in length (Green *et al.* 2002). Superficially, it is a small brown bird like other sparrows that can occur in its habitat, such as the Savannah Sparrow (*Passerculus sandwichensis*) and Grasshopper Sparrow (*Ammodramus savannarum*). Unlike other sparrows, however, the Baird's Sparrow has a yellowish-ochre face that is largely unmarked, apart from two dark spots behind the cheeks and two thin "moustache" marks angling down from near the beak. Its breast, too, is distinctively marked, with a necklace of thin streaks across the top of the breast and no other streaks except high along the flanks.

This species is generally secretive, and is most often detected during the breeding season by its song—a series of introductory notes followed by a trill, similar to the song of the Savannah Sparrow, but having a more wiry, musical quality and usually only one, rather than two, trills. There are 13 song types, with seven types accounting for 89% of songs; individuals sing only one song type throughout their life (Green *et al.* 2002).

Population Spatial Structure and Variability

The species' population genetics have not been studied. Genetic differentiation across the range might be reduced by the tendency of adults to breed in different places from one year to the next (Green *et al.* 2002). Conversely, genetic differentiation might have been increased by historical and ongoing fragmentation of its habitat (Wiggins 2006). Thus, no conclusions on population structure are possible without further study.

Designatable Units

No subspecies have been described (Green *et al.* 2002), and the range is not disjunct. Hence, the species is treated as one designatable unit.

Special Significance

Along with Sprague's Pipit (*Anthus spragueii*), Chestnut-collared Longspur (*Calcarius ornatus*) and McCown's Longspur (*C. mccownii*), the Baird's Sparrow is one of a few species that are restricted to breeding in the northern prairies and are valuable grassland indicator species for that region (Browder *et al.* 2002; Askins *et al.* 2007). No published Aboriginal Traditional Knowledge particular to this species is currently available.

DISTRIBUTION

Global Range

The breeding range of Baird's Sparrow (Figure 1) largely coincides with the extent of the northern Great Plains—from southern Alberta, southern Saskatchewan, and southwestern Manitoba south to central and eastern Montana, eastern Wyoming, northern South Dakota, and, locally and rarely, northwest Minnesota (Green *et al.* 2002; Luce and Keinath 2003). Historically, the eastern edge of the range extended to Winnipeg in Manitoba and throughout northwestern Minnesota. The species winters from southeast Arizona and northeast Sonora east through southern New Mexico and southwest Texas, and south in Mexico to northeast Chihuahua, western Coahuila, northeast Durango, and northern Zacatecas (Figure 1).

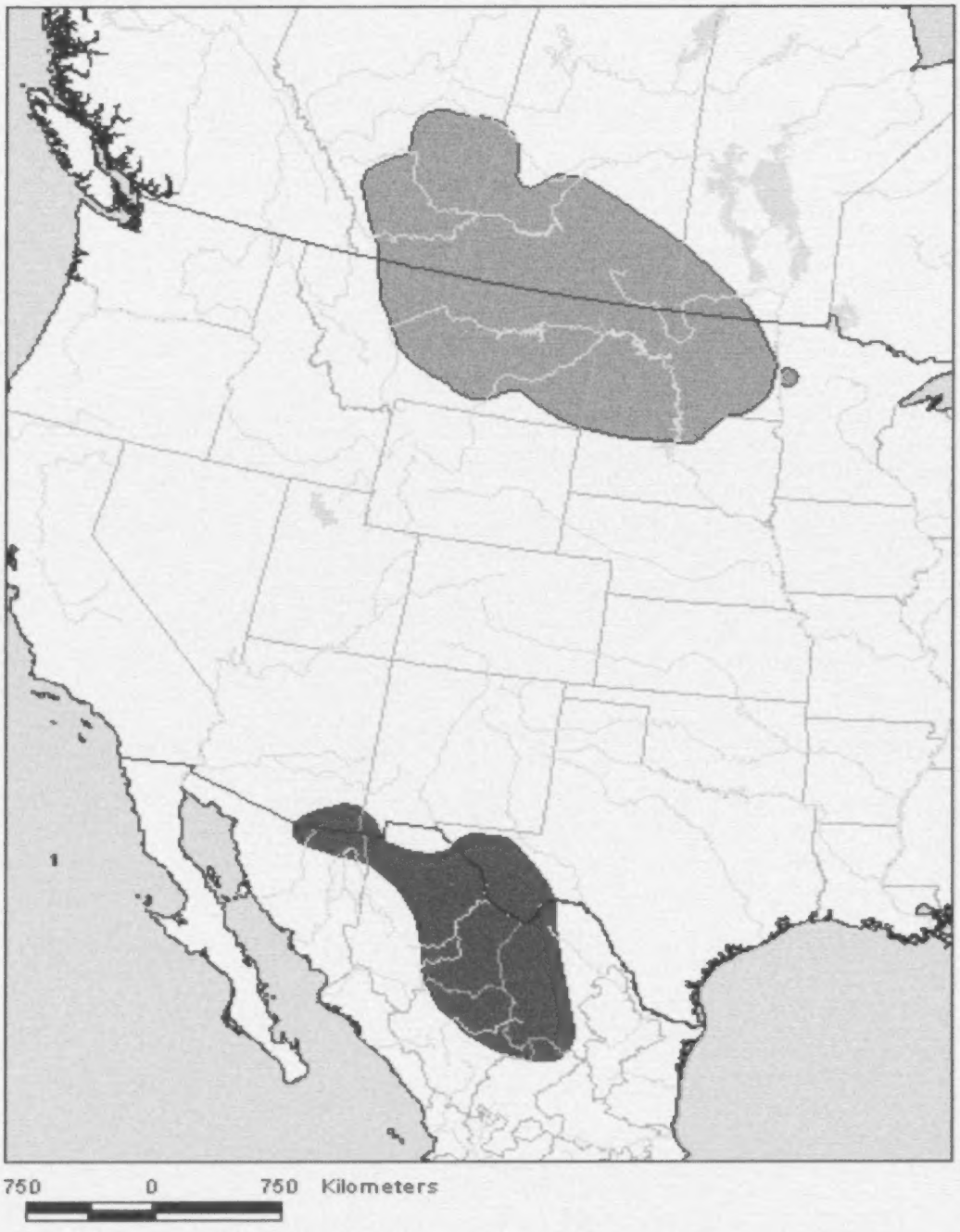

Figure 1. Breeding (red) and wintering (blue) range of Baird's Sparrow (NatureServe 2009). The far eastern edge of the range depicted in Manitoba, North Dakota and Minnesota largely reflects historical occurrences. The species is apt to be rare, localized and ephemeral at the extremities of its breeding range.

Canadian Range

About 45% of the Baird's Sparrow's breeding range is within Canada (based on Figure 1). The Canadian range coincides with the Prairie Ecozone of Alberta, Saskatchewan, and Manitoba (Figure 1). Breeding density is highest in the Moist Mixed and Mixed Grassland ecoregions, and lower in the Aspen Parkland and Cypress Hills Ecoregions. The western edge of the Canadian range is roughly the 115th meridian just west of Edmonton, Red Deer, and Calgary. The northern edge falls along the North Saskatchewan River in Alberta (Federation of Alberta Naturalists 2007), and angles southeast to the Assiniboine River in Saskatchewan and Manitoba (Smith 1996; De Smet 2003; Saskatchewan Conservation Data Centre 2008). In Manitoba, recent records are restricted to the extreme southwestern part of the province (K. De Smet pers. comm. 2012).

The species' range is unchanged from its historical occurrence in Alberta and Saskatchewan, as far as records indicate (Smith 1996; Federation of Alberta Naturalists 2007), but in Manitoba, Baird's Sparrows historically (i.e., in the late 1800s) were common north to Swan River and Lake St. Martin and east at least to Winnipeg. Breeding was recorded in this part of the range as late as the 1930s, although already by this time such records likely represented temporary extra-limital breeding caused by severe, widespread drought (De Smet 2003; K. De Smet pers. comm. 2012). In the late 1980s, there again were scattered breeding season records in Manitoba north to just south of Dauphin and east slightly beyond Winnipeg, again probably in response to drought (De Smet 2003). A similar range extension into historically occupied areas occurs in the wintering grounds in southeast Arizona, where birds spread from Cochise County to northern Graham County, again apparently in response to drought (Monson and Phillips 1981 cited in Green *et al.* 2002).

The extent of occurrence for Baird's Sparrow in Canada is 410,000 km^2 (the area within a minimum convex polygon enclosing the range in Figure 1). An index of the area of occupancy cannot be reliably calculated for this species, because data have been collected at too coarse a scale (e.g., breeding bird atlases) and not all apparently suitable habitat is occupied (especially because of the bird's area sensitivity and clumped distribution; see **Habitat Requirements**, below), but is certainly greater than 2000 km^2, based on a 2x2 km grid. The number of breeding locations is unknown, because of the species' wide distribution and the difficulty of carrying out an exhaustive search for it.

Search Effort

Search effort is fair for this species. It is sought after by birders and is systematically searched for in several continent-wide bird monitoring programs (see **Sampling Effort and Methods** below), as well by surveys of grassland birds within individual provinces or states (e.g., Igl and Johnson 1997; Davis *et al.* 1999). Nonetheless, the bird's clumped distribution, variable tenure of breeding sites across years, and specialized habitat are all challenges to assessing its distribution. Also, outside of the breeding season, this species is secretive and easy to confuse with congeneric species, so that information about its distribution on migration and on the wintering grounds is poor.

HABITAT

Habitat Requirements

Baird's Sparrows breed mainly in native mixed grass and fescue prairie with scant or no shrubs (Green *et al.* 2002), although they also nest in anthropogenic habitats having features similar to natural prairie, such as dry wetland basins, wet meadow, planted cover, or dense grass within hay or crops (Dechant *et al.* 2002). This sparrow appears to be somewhat more tolerant to agricultural habitats than some other obligate-grassland birds like Sprague's Pipit.

In a study examining area sensitivity of prairie birds, Davis (2004) found that the occurrence of five species, including Baird's Sparrow, was positively related to patch size. However, minimum size requirements were lower for Baird's Sparrow and Chestnut-collared Longspur (25 and 39 ha, respectively) than they were for Grasshopper Sparrow and Sprague's Pipit (134 and 145 ha, respectively). This further suggests that the Baird's Sparrow has a greater range of habitat tolerances than some other grassland-obligate species like Sprague's Pipit.

A review of 24 studies across the Baird's Sparrow's breeding range shows highest densities in areas with patchy, moderate grass heights (20-100 cm) that have some litter cover (< 2 cm deep; Dechant *et al.* 2002). Shrubs can be present but only at low densities (De Smet and Conrad 1991; Grant *et al.* 2004). They may be used as song posts, although the birds also often sing from the ground or tufts of grass (Green *et al.* 2002).

Some studies show that native herbaceous vegetation is preferred (e.g., Winter 1994; Madden 1996; Dale *et al.* 2005), whereas others do not (e.g., Anstey *et al.* 1995; Sutter *et al.* 1995; Davis *et al.* 1996, 1999), perhaps because the structure rather than species composition of the habitat attracts birds (Sutter and Brigham 1998; Martin and Forsythe 2003). However, this explanation has not been directly tested. Where breeding occurs in hay and cropland, productivity appears to be low in hay (Dale *et al.* 1997; McMaster and Davis 1998) and nil in cropland (Martin and Forsyth 2003), in some cases depending on the timing of haying (McMaster *et al.* 2005). Nonetheless, in pasture, non-native and native vegetation can yield similar reproductive outputs (Davis and McMaster unpublished data). Thus, some, albeit not all, superficially suitable habitats in agricultural landscapes may be ecological traps (Battin 2004) for this species. The amount of native grassland in the landscape as a whole might be a key determinant of the species' success across these different habitats (Davis *et al.* unpublished data).

Territory sizes generally range from 0.4-1.5 ha across studies (Wiggins 2006), although they can be up to 2.25 ha (Winter 1994). Individuals might use the presence of conspecifics to find suitable habitat, resulting in a clumped distribution of birds across areas of suitable habitat (Ahlering *et al.* 2006), a distribution that some authors (e.g., NatureServe 2009) refer to as loosely or semi-colonial.

Densities change greatly with local conditions, making overall population trends hard to determine (see **Fluctuations and Trends** below). Most of this variation appears to be related to moisture, with drier areas favoured in wet years, and moister areas in dry years. Thus, the sparrow's local distribution can shift from prairie sloughs and wet meadows to upland grasslands across different years (Dechant *et al.* 2002). At any given site, breeding density might increase when precipitation is low (e.g., George *et al.* 1992) or when it is high (e.g., Ahlering *et al.* 2009).

Beyond these basic habitat requirements, various factors can render habitat either more or less suitable. Heavily grazed habitat is not occupied, but light to moderate grazing is tolerated, and might in fact be needed to maintain and improve habitat by keeping grass short and shrubs sparse. The levels of grazing that are beneficial, however, are strongly dependent on local conditions, especially moisture regimes (Schneider 1998; Dechant *et al.* 2002; Bleho 2009; Lusk 2009). Similarly, burning and mowing can destroy habitat in the short term, but can help maintain it over the long term (Pylypec 1991; Dale *et al.* 1997; White 2009). Roads and gas wells are associated with lower densities of Baird's Sparrows, perhaps because of edge effects and/or because the sparrows avoid approaching these areas (Sutter *et al.* 2000; Linnen 2008; Dale *et al.* 2009). Where gas wells are sparse, however, abundance might be higher near wells, in response to nearby vegetation structure (H. Bogard and S. Davis unpublished data). Other recent unpublished data show mixed and relatively weak effects of natural gas development on Baird's Sparrow abundance, density and reproductive success (S. Davis pers. comm. 2012).

Nests are made of grasses, stems, and leaves, lined with narrow grass, rootlets, fur, string, or moss setae (Wiggins 2006). Nest sites have less bare ground, deeper litter, and taller and denser vegetation than elsewhere within a bird's territory (Green *et al.* 2002; Dieni and Jones 2003; Jones and Dieni 2007).

The limited data on winter habitat suggest that individuals stay within a home range (Gordon 2000). They appear to be solitary on the wintering grounds, (Grzybowski 1983; Panjabi *et al.* 2010). More birds are found in areas with more grass (Carter *et al.* 1998; Panjabi *et al.* 2010) and in areas with higher grass cover and taller grass than in less-vegetated habitats (Macías-Duarte *et al.* 2009). Over the long term, moderate grazing, and possibly burning, might be beneficial for the same reasons as given for breeding habitat, above (Gordon 2000). As with breeding habitat, there appears to be a preference for native grassland (Levandoski 2008), and wintering density is affected by annual precipitation (Gordon 2000). In addition, Panjabi *et al.* (2010) found Baird's Sparrows only in flatlands and rolling hills.

Habitat Trends

Since European settlement in the late 1800s, at least 70-75% of the Great Plains native prairie habitat in both the US and Canada has been destroyed, mainly by conversion to agriculture (Hammermeister *et al.* 2001; Nernberg and Instrup 2005; Askins *et al.* 2007). Most of the prairie habitat that remains has been strongly degraded. Previously, it had been a dynamic, heterogeneous ecosystem maintained by cycles of drought, grazing, and fire (Askins *et al.* 2007). As it was settled, however, natural grazing patterns were disrupted by fencing and by local extirpations of the main grazers (notably prairie dogs, *Cynomys* spp., and Plains Bison, *Bison bison*), fires were suppressed, and habitat was severely fragmented (Radenbaugh 2003; Askins *et al.* 2007).

Habitat destruction and degradation are continuing throughout the species' range. On the Canadian prairie between 1985 and 2001, the most recent period for which trends are available (M. Watmough pers. comm. 2010), the area of native grassland, at least in agriculture-dominated landscapes, dropped by 10% (95% CI: 13-8%; Watmough and Schmoll 2007). Most of this loss involved conversion to tame (i.e., planted) grass and to cropland, mostly in remnant grassland fragments (Watmough and Schmoll 2007; M. Watmough pers. comm. 2010). Although the area of total grass increased because of planted non-native hay cover, this habitat is less frequently settled by Baird's Sparrows than grazed non-native cover (McMaster and Davis 1998) and the birds that do settle in the former habitat are rarely productive (Dale *et al.* 1997). Additional concerns about habitat loss now stem from the Canadian government's announcement in spring 2012 that it will be phasing out the Community Pasture Program over the next 5 years. How this might affect Baird's Sparrows is unknown, but loss of this program has the potential to affect hundreds of thousands of hectares of native rangeland that have been conserved since the 1930s.

Fragmentation and invasion by exotic species continue to reduce and degrade breeding habitat (Hammermeister *et al.* 2001; Gauthier and Wiken 2003). In Alberta and Saskatchewan, grassland is being degraded by oil and gas development. The number of gas wells in the species' range increased 200-300% since the 1980s, with well sites, trails, pipelines, and seismic lines destroying and fragmenting the habitat (Linnen 2008; Davies and Hanley 2010).

Similar trends are apparent in the US and Mexican portions of the range. In Montana, from 1982 to 1997, 5-10% of native prairie on privately owned land was lost (Conner *et al.* 2001). In North and South Dakota, between 1989 and 2003, 5.2% of native grasslands of one of the most intact regions (the Missouri Coteau) were lost (Stephens *et al.* 2009). Similarly, on the wintering grounds in Mexico, at least 50% of native grassland has been lost historically, and conversion of native grassland to crops continues at a pace that, while undocumented, is likely much higher than on the breeding grounds (Desmond and Montoya 2006; Macias-Duarte *et al.* 2007).

BIOLOGY

Baird's Sparrows have been the subject of many studies across their breeding range, most of which have focused on habitat preferences (reviewed in Dechant *et al.* 2002; Green *et al.* 2002; Davis 2003; Wiggins 2006). However, much basic information on demography, movements, and wintering habits is lacking.

Life Cycle and Reproduction

Age at first breeding and lifespan are unknown. Birds are known to have bred in the year following their hatch dates (S. Davis pers. comm. 2011), and are known to have lived up to 4.5 years (B. Dale and S. Davis pers. comms. 2011). The congeneric Grasshopper Sparrow breeds in its first year and lives 3 years on average (Delany *et al.* 1993, cited in Vickery *et al.* 1996). If the same is true of Baird's Sparrows, then their generation time is likely 2-3 years.

Nests are started in late May. Incubation lasts 11-12 days, and young leave the nest, still flightless, after 8-11 days (Davis and Sealy 1998; Davis 2003). Some individuals have another round of nesting late in June through early August (Green *et al.* 2002; Wiggins 2006). These nests might be renests after a first nesting attempt failed, but they might also be true second broods (i.e., nesting again after successfully raising a first brood). Actual second broods are thought to have been documented at least twice (Davis and Sealy 1998; Jones unpublished, cited in Jones *et al.* 2010), although predation of the first brood soon after fledging cannot be ruled out (S. Davis pers. comm. 2011).

Most clutches have four or five eggs (range 2-6; Wiggins 2006), with smaller clutches occurring as the breeding season advances (Davis and Sealy 1998; Davis 2003; Jones *et al.* 2010). Brood size averages 3-4 nestlings, most of which survive in successful nests, although across all nests only 1.5 young fledge on average (Davis and Sealy 1998; Green *et al.* 2002; Davis 2003; Jones *et al.* 2010). Nest success (i.e., the percentage of nests that fledge any young at all) varies across studies, from 26-54% (Jones *et al.* 2010), with most nests failing because of predation (Green *et al.* 2002; Davis 2003; Lusk 2009; Jones *et al.* 2010).

There is no information on annual survival, because return rates of banded birds are so low (< 5%; see **Dispersal and Migration** below).

Physiology and Adaptability

As noted earlier, settlement and successful breeding are highly sensitive to local patterns of rainfall and drought conditions. The sparrows settle elsewhere when local conditions are too wet or too dry, but their ability to do so of course depends on the availability of alternative sites. The birds are also able to settle in crop or 'tame' (cultivated) hay when native grassland or suitable pasture is unavailable, but their breeding success in these habitats may be very poor (see **Habitat Requirements** above).

Dispersal and Migration

Birds leave their wintering grounds between March and May, with a peak in late April, and begin to arrive on the Canadian breeding grounds in the first week of May, with most birds arriving after late May. Southward fall migration probably starts in September through October (Green *et al.* 2002). Birds migrate singly or in small flocks by night (Thompson and Ely 1992). They moult during fall migration, possibly staging in the northern part of their winter range where late-summer rains are heavy enough to increase food availability, proceeding farther south when the still heavier rains there have ceased (Voelker 2004).

Site fidelity to breeding areas is very low; fewer than 5% of adults return to the same areas to breed in successive years (Green *et al.* 2002; Jones *et al.* 2007). Fidelity to wintering areas at three sites in Arizona ranged from 0 to 10% (n=15-28 banded birds per site; Gordon 1999).

Interspecific Interactions

Predators of adult Baird's Sparrows are undocumented, apart from one apparently taken by a weasel (Green *et al.* 2002), but presumably they include all the medium-sized raptors and carnivorous mammals that prey on other prairie songbirds (e.g., Pietz and Granfors 2000). Nest predators that have been suspected of preying on eggs and nestlings include skunks, ground squirrels, mice, badgers, foxes, and coyotes (Green *et al.* 2002). Northern Harriers (*Circus cyaneus*) and Merlins (*Falco columbarius*) are known to take fledged young (Lane 1968) and presumably also prey on adults.

Brown-headed Cowbirds (*Molothrus ater*) lay their eggs in the nests of other songbird species, including Baird's Sparrows, leaving the host parents to raise the cowbird young. The frequency of this brood parasitism varies considerably across different sites (see **Threats**, below), but can affect up to 77% of Baird's Sparrow nests (Davies and Sealy 2000), reducing the number of young sparrows raised at successful nests (i.e., nests that raise at least one fledgling) by one to two birds on average (Davis and Sealy 1998; Green *et al.* 2002).

Interspecific competition with other prairie songbirds over perches for singing and with other wintering sparrows over winter food resources has been suggested, but is undocumented (Green *et al.* 2002). In the only detailed study, the Baird's Sparrow's general habitat needs were very similar to those of the congeneric Grasshopper Sparrow, but its microhabitat was sufficiently different that no competition was apparent (Gamble 2005).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

The North American Breeding Bird Survey (BBS) provides the most geographically extensive and the longest time series of population trend monitoring. Data are collected by volunteers, who tally all the birds they encounter at 50 stops along 39.2-km roadside routes distributed throughout the US and southern Canada. The routes were selected according to a stratified random design, and usually the same participant covers a given route every year, so the consistency of coverage and level of effort is good. One of the main drawbacks of the method is that some species avoid roads (including, perhaps, Baird's Sparrows; Sutter *et al.* 2000), so their numbers might be underestimated. BBS sampling coverage is also weak for species like Baird's Sparrow, which have specialized habitat needs (e.g., core grasslands), clumped distributions, and relatively small breeding ranges. Lower detection rates might also decrease sensitivity for detecting trends (Dale *et al.* 2005).

A second source of trend data, the Grassland Bird Monitoring program (GBM), was started in the Canadian prairies in 1996 to provide more intensive BBS coverage in undersampled grassland habitats, so that trends in grassland birds could be measured more precisely. Thirty-five BBS-style routes were selected where remaining grasslands are concentrated in southeast Alberta and southwest Saskatchewan, along roads that need only be passable, rather than secondary roads as in the BBS. The GBM thus samples habitat that is less-interrupted than the BBS, and does so within the core Canadian range of several grassland species of conservation interest, including Baird's Sparrow (Dale *et al.* 2005). As of 2009, GBM data have been incorporated into the Canadian BBS analysis, but not yet for the rangewide analysis.

Breeding bird atlases also provide some information on songbird population sizes and trends. A province or state is divided into 10x10 km squares, and for 5 years, volunteers try to find all species that are breeding within each square. Ideally, the program is repeated every 20 years, giving some information on trends, albeit only at the coarse level that presence/absence within 10X10 km squares can offer. In the Canadian portion of the breeding range, atlas information is available only for Alberta (1987-1992 and 2000-2005), though an atlas project was launched in Manitoba in 2010, and an atlas with distinctive methods that offer no trend information as yet is ongoing in Saskatchewan (Smith 1996; Saskatchewan Data Centre 2008).

Survey effort in the Baird's Sparrow's wintering range is insufficient to yield useful information on trends. Christmas Bird Counts (CBCs), which are 1-day winter counts that are useful for detecting trends of many passerines, yield too few sightings of Baird's Sparrows to be useful for this species, because of its secretiveness and because most of the population winters in Mexico, which is not well-surveyed by the CBC. Over the past decade, only 2-21 individuals were reported per year, all from the US (National Audubon Society 2010).

Abundance

The global population is estimated from BBS data as 1.2 million individuals. About 715,000 individuals (60% of the global population) breed in Canada (Rich *et al.* 2004). The precision of that estimate is coarse, however, with 95% confidence limits that are on the order of 50% of the estimate, which yields a range of 350,000-1,100,000 birds (Blancher *et al.* 2007).

Fluctuations and Trends

At any given locality, birds can be abundant or absent from one year to the next, and densities across whole regions can fluctuate widely, perhaps because birds move from one region to another to find suitable breeding sites (COSEWIC 1996). Thus, variation in population indices (e.g., Figure 2) might not necessarily represent fluctuations in the population as a whole. This makes overall trends hard to evaluate.

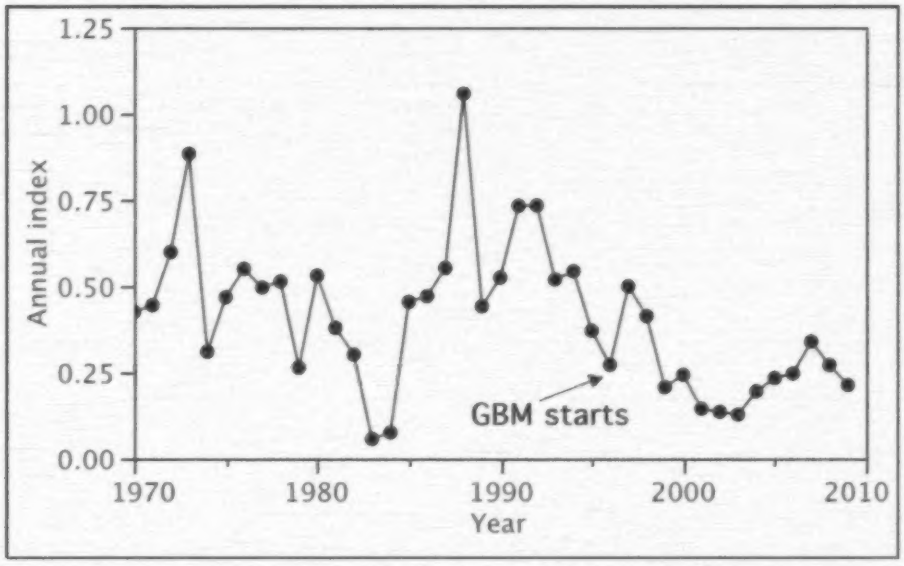

Figure 2. Breeding Bird Survey abundance indices for Baird's Sparrow in Canada, 1970-2009 (including Grassland Bird Monitoring program data after 1995; from Environment Canada 2010).

The only Canadian breeding bird atlas program in the Baird's Sparrow's range that has been repeated, Alberta's, reported a statistically significant decline in its probability of detection in the Grassland Region in the 13 years between atlas projects (1987-1992 and 2000-2005). Unfortunately, the methods used in the two atlas periods differed, and so do not allow a reliable measure of the true magnitude of change, beyond detecting whether it is statistically significant (Federation of Alberta Naturalists 2007). In Manitoba, there is a high and growing level of concern over population declines of Baird's Sparrows (K. De Smet and C. Artuso pers. comms. 2012).

BBS results for Canada (which now includes GBM data) show peaks and declines in annual abundance since the BBS program began (Figure 2), such that the strength and direction of the species' population trend changes radically depending on the time window being examined. These variations might well be related to periods of drought (COSEWIC 1996; De Smet 2003).

The long-term BBS trend for Canada since 1970 is -2.0%/year (95% CI: -4.5, 0.6, n=104, P=0.14), and -5.8%/yr over the past two decades (1989-2009; 95% CI: -9.6, -1.9, n=91, P=0.005; Environment Canada 2010). More recently, the decline appears to have shown signs of levelling out (Figure 2), but this could be a temporary phenomenon.

Rather than use the customary recent 10-year trend estimate (i.e., from 1999-2009), the recent trend was calculated for 1996-2008. This is because this time period coincides both with the start of the GBM and incorporates start and end years when climatic conditions in western Canada were similar, which is an important consideration for a species that responds to annual climatic fluctuations (B. Dale and B. Collins pers. comms. 2009). As with the long-term estimate, this shorter-term trend estimate also suggests a decline, but it is not statistically significant (-2.8%/year, 95% CI: -6.7, 1.2, *n*=60, P=0.16).

For the Baird's Sparrow, the combined BBS dataset from both Canada and the US, rather than from Canada alone, is considered to be a more appropriate source for estimating trends. This is because regional populations can fluctuate considerably and birds are thought to range widely in some years in search of suitable breeding habitat (COSEWIC 1996; B. Dale pers. comm. 2009). The long-term trend for this dataset (1966-2009) is -2.9%/year (95% CI: -4.9, -1.4, *n*=200), which represents a statistically significant decline of 72% over 44 years. Over the past decade (1999-2009), however, the trend again appears to be essentially stable (-0.5%/year, 95% CI: -5.5, 4.6; Sauer *et al.* 2011), which seems to part of a repeating pattern of loss followed by short-term stability (see Figure 3). Such patterns confound the meaningful calculation of short-term trend estimates. All things considered, it is believed that the best inference for the species' 10-year population trajectory should be interpolated from the long-term trend pattern. Using the long-term, survey-wide trend of -2.9%/year yields an estimated 10-year trend of -25% (95% CI: -39, -13). While this is thought to represent the best available estimate, it is based on the assumption that the long-term trend follows a simple linear relationship. Because this relationship is not clear, caution should be used when considering the precision of the values calculated, and when applying them to COSEWIC's quantitative criteria for rates of population decline.

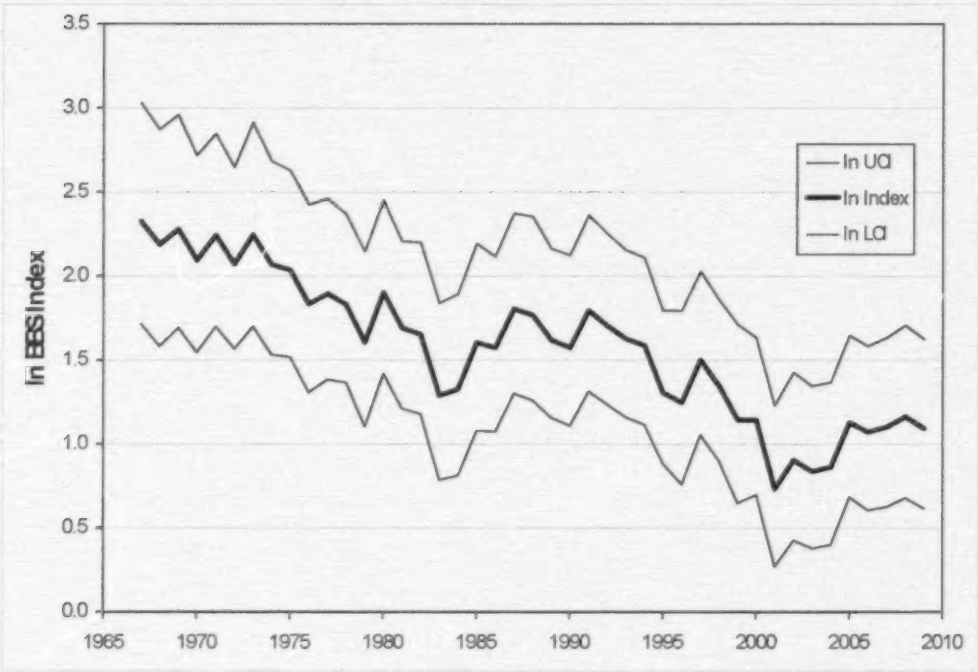

Figure 3. Baird's Sparrow rangewide population trend in North America from 1967 to 2009, based on a hierarchical analysis of Breeding Bird Survey data (adapted from Sauer *et al.* 2011).

Rescue Effect

The long-term population trend of Baird's Sparrows in the US is -3.5%/year according to BBS data for the period 1988-2009 (95% CI: -5.5, -1.3; Sauer *et al.* 2011), suggesting that rescue is unlikely. Although this trend may have levelled out in the past 10 years (-0.2%/year, 1999-2009; CI -6.2%, 7.5%), Baird's Sparrows appear to shift their breeding sites across a wide geographic area depending on local conditions largely related to climate (COSEWIC 1996; Green *et al.* 2002). As such, the Canadian and American populations effectively represent a single population. If regional populations in the US and Canada are inextricably linked, as is thought, then one region's declining population cannot rescue the other, at least not over the long term.

THREATS

Habitat Destruction and Degradation

The main threat to Baird's Sparrows, both historically and currently, is habitat destruction and degradation. Threats to breeding and wintering grassland habitats are ongoing and likely to increase in Canada (CEC and TNC 2005), the US (Stubbs 2007), and Mexico (Panjabi *et al.* 2010).

Habitat is being lost mainly through the conversion of native grassland to cropland (Wiggins 2006). Degradation of breeding habitat is occurring, in part, from infiltration by invasive exotic plants such as Smooth Brome (*Bromus inermis*), Leafy Spurge (*Euphorbia esula*), Spotted Knapweed (*Centaurea stoebe*), Crested Wheatgrass (*Agropyron cristatum*), and Yellow Sweet Clover (*Melilotus officinalis*; Wilson and Belcher 1989; Forest *et al.* 2004).

Breeding habitat has also been strongly degraded by urbanization, roadways, shelterbelts and, especially in the last 20-30 years, energy development (Sutter *et al.* 2000; Askins *et al.* 2007; Dale *et al.* 2009). Habitat fragmentation breaks up the larger areas that the birds prefer (Davis 2004) and exacerbates other threats, specifically by exposing their habitat to infiltration by exotic and woody vegetation (Trombulak and Frissell 2000), and by increasing vulnerability to nest parasitism by cowbirds (Davis and Sealy 1998).

The infrastructure associated with energy extraction, such as roads, transmission lines, and pipelines contributes heavily to the projected increase in habitat fragmentation and localized habitat destruction (see **Habitat Trends**). In the Baird's Sparrow's breeding range, the number of gas wells approximately tripled in the last 20 years in Canada (Linnen 2008) and doubled in the last 30 years in the US (Copeland *et al.* 2009; Naugle *et al.* 2010). As a result, over 30,000 ha of grassland habitat have been impacted by well sites, trails, or pipelines and 65,000 ha of edge habitat have been created by seismic lines. To meet anticipated demands from population growth, it is predicted that an additional 9000 ha of grassland habitat per year may be destroyed until petroleum reserves are depleted (CPPF 2004).

While the geographic scope of threats stemming from energy development in the Prairies appears to be large, little is currently known about the severity of these threats. Studies have found that Baird's Sparrows avoid traditionally constructed oil development (Linnen 2008) and gas wells (Linnen 2008; Dale *et al.* 2009). However, recent unpublished data from southwestern Saskatchewan and southeastern Alberta show mixed and relatively weak effects of natural gas development on the abundance, density and reproductive success of this species (S. Davis pers. comm. 2012). More work is required to determine whether, or how much, habitat degradation resulting from energy development impacts Baird's Sparrow populations.

Wind energy development, too, is accelerating in both Canada, where the three prairie provinces plan to at least double their capacity over the next 5 years (CANWEA 2010), and the US, where North and South Dakota are among the top 11 states in wind energy production (AWEA 2010). Like petroleum development, wind farms cause habitat fragmentation because of the associated roads, transmission lines, and turbines (Leddy *et al.* 1999; Pruett *et al.* 2009).

Finally, on the wintering grounds in northern Mexico, grasslands are increasingly being lost and degraded through agricultural conversion, desertification, shrub encroachment, and poor grazing management (Panjabi *et al.* 2010).

Disruption of Natural Processes

Disruption of the natural processes that maintained habitat historically is an ongoing threat throughout the Baird's Sparrow's range (CEC and TNC 2005). Grazing by cattle is more intensive and uniform in most areas than the grazing by natural herbivores was historically, disrupting the dynamic, heterogeneous landscape that this species relied on historically (Askins *et al.* 2007; Toombs and Roberts 2009). Similarly, natural drought cycles, which also were important in maintaining this landscape, are disrupted by such factors as groundwater depletion (e.g., because of irrigation) and changes in natural levels or flow patterns (e.g., through draining; CEC and TNC 2005; Wiggins 2006). Fires, too, helped maintain habitat historically, but they now occur on artificial schedules that are rarely optimal for grassland birds (Askins *et al.* 2007). If timed appropriately, fires can help maintain habitat, but they render habitat unsuitable for Baird's Sparrow for at least the first year after burning (Pylypec 1991; Madden *et al.* 1999; Danley *et al.* 2004; White 2009).

Other Threats

Other threats to Baird's Sparrows include agricultural operations, heightened levels of cowbird parasitism, pesticides, and climate change. Their relative importance is unknown, but in each case some sort of negative impact on Baird's Sparrows has been documented.

Specifically, agricultural operations such as haying can kill birds and their eggs and young, although haying late in the season in alternate years or less frequently can help maintain the shorter grass the birds prefer (Dale *et al.* 1997). Nest parasitism by cowbirds reduces nest success by one to two young per nest (Davis and Sealy 1998). Cowbird parasitism was considered rare historically (Lane 1968), although that might be because so few Baird's Sparrow nests had been studied before the 1980s (Green *et al.* 2002); there is some evidence that the species has evolved defences against parasitism (Klippenstine and Sealy 2008). In any case, cowbird parasitism now affects 4-77% of nests (Wiggins 2006; Davis and Sealy 2000; Jones *et al.* 2010).

Pesticides are a potential threat to several species of grassland songbirds (McEwen and Ells 1975; Mineau *et al.* 2005). The one study specifically testing their effect on Baird's Sparrows showed that Furadan, a cholinesterase inhibitor used to control grasshoppers, whose use has recently been eliminated from the US and Canada, but probably not in Mexico (FMC Corporation 2009), reduces reproductive success (Martin *et al.* 2000).

Climate change models predict warming and drying of the northern Great Plains over the next century, which will push prairie habitats northward (Sauchyn *et al.* 2009). A similar warming trend over the past century likely accounts for broad-scale changes in vegetation that have already been documented across the northern Great Plains for that period (Piwowar 2010). Models of how climate change would affect individual grassland bird species were inconclusive for Baird's Sparrow, but predicted a northward range shift for most species, including Grasshopper Sparrow, which has very similar breeding habitat needs (Price 1995). More immediately, a higher frequency and severity of droughts in the sparrow's range, which is already occurring and will likely continue (Johnson *et al.* 2005), may compromise habitat quality and reproductive success for the foreseeable future.

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

Like most other migratory birds in North America, Baird's Sparrows and their nests are protected from harm through the Canada-US *Migratory Birds Convention Act*. They are not currently afforded protection under Canada's *Species at Risk Act*, because they were assessed by COSEWIC to be Not at Risk (COSEWIC 1996). In Manitoba, Baird's Sparrow is designated as Endangered under the *Endangered Species Act*, which protects the birds, their habitat, and any of their needed resources from harm or disturbance.

The species is also legally listed in four states, two in its breeding and two in its wintering range (Table 1).

Table 1. Conservation status of Baird's Sparrow in the United States and Canada (from NatureServe 2009).

Jurisdiction	Status*	
IUCN	**Least Concern**	
Canada	N4B	
Alberta	S3B	
Manitoba	S1S2B	Endangered
Saskatchewan	S4B	
United States	N3B, N2N	Bird of Conservation Concern
Arizona	S2N	Threatened
Colorado	SNA	
Kansas	SNA	
Minnesota	S1B	Endangered
Montana	S2B	Species of Special Concern
Navajo Nation	SNR	
Nebraska	SNRN	
New Mexico	S1B	Threatened

Jurisdiction	Status*
IUCN	**Least Concern**
North Dakota	SU
South Dakota	S2B
Texas	S2
Wyoming	S1?B

*N (at start of rank) = National; S = Subnational; B = Breeding; and N (at end of rank) = Nonbreeding. 1 = Critically Imperilled; 2 = Imperilled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NA = Not Applicable; NR = Not Ranked; U = Unrankable (due to lack of information or conflicting information); ? = inexact numeric rank.

Non-Legal Status and Ranks

The IUCN Red List categorizes the species as Least Concern (BirdLife International 2009), but it is on the Watch Lists of Partners in Flight and the Audubon Society, which categorizes it as Red (i.e., declining rapidly, with a very small population and/or limited range, and facing major conservation threats; Butcher *et al.* 2007; Partners in Flight 2010). The difference in categorization between IUCN and the latter two bodies is likely because of the greater weight placed on population declines by Partners in Flight and Audubon (Butcher *et al.* 2007).

The NatureServe Status Rank for Baird's Sparrow in Canada is N4B (apparently secure when breeding). It is also ranked as S4B in Saskatchewan, but Alberta and Manitoba give it lower ranks of S3B and S1S2B, respectively (Table 1). In the United States, the Baird's Sparrow is considered as a Bird of Conservation Concern, which gives it some conservation priority. There it is ranked N3B, N2N (vulnerable breeding, imperilled nonbreeding) nationally, but all the states that have ranked the species give it a lower rank, and three (Minnesota, New Mexico, and Wyoming) give it a rank of S1 (critically imperilled).

Habitat Protection and Ownership

In Alberta, just over half of grasslands are on Crown land (56% Crown, 44% private; Nernburg and Ingstrup 2005), while in Saskatchewan, at least 30% of native grassland is under some form of protection by government or by non-government organizations (NGOs; Hammermeister *et al.* 2001). While most NGO properties target grasslands conservation, the nature of protection of government lands varies widely, as they include community pastures, lands protected by the *Wildlife Habitat Protection Act*, and parks (Hammermeister *et al.* 2001). There is also now uncertainty about the fate of large areas of native rangeland in the Prairie provinces, because of the recent decision to cut the Community Pasture Program on Crown lands.

Notable examples of protected areas include Canadian Forces Base Suffield National Wildlife Area in Alberta and Grasslands National Park in Saskatchewan. Overall, the percentage of the Prairie Ecozone managed specifically for conservation is quite low: 1% in Alberta and Manitoba, and 9% in Saskatchewan (Gauthier and Wiken 2003), with only 15% of native grasslands across the species' entire range occurring in protected areas (CEC and TNC 2005).

Even on dedicated conservation lands, habitat management is often inappropriate for Baird's Sparrows. "Protection" does not usually include protection from energy development, except in National Parks and possibly the Suffield NWA. Another example is the US Conservation Reserve Program (CRP), which does not allow grazing, which can help arrest succession at a stage favoured by this species (Askins *et al.* 2007). Lands managed under CRP often contain introduced alien grasses, instead of the native grasses the bird prefers (Wiggins 2006).

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